REMARKS

Claims 1-14 are pending. Claim 14 has been amended. Reconsideration is respectfully requested.

1. Objection to Specification

The application was objected to for not containing an abstract of the disclosure. The specification has been amended to include an abstract. No new matter has been added. Approval of the abstract is requested.

2. Rejection of Claim 14 Under §112

Claim 14 stands rejected under 35 U.S.C. 112, first paragraph, for failing to comply with the written description requirement because claim 14 recites "computer usable medium," which is not disclosed in the specification and original claim.

Claim 14 has been amended to remove "computer usable medium" in favor of reciting a "computer-readable medium encoded with a computer program" for implementing the claimed method. Approval of the amended claim is requested.

3. Rejection of Claim 1 Under §112

Claim 1 stands rejected under 35 U.S.C. 112, second paragraph, for being indefinite because claim 1 recites "converting a first motion vector field into a second motion vector field by determining a first one of the motion vectors of the second motion vector field," yet there is no explicit disclosure how it is converted and what the second motion vector field means. The Applicants respectfully disagree.

The conversion of the first motion vector field into the second motion vector field is best succinctly described on page 9, lines 8-27, where a motion vector field (MVF1) is converted into a second motion vector field (MVF2). The claimed conversion involves updating (i.e. replacing) one or more motion vectors in the first motion vector field, to result in the second motion vector field. While most of the vectors in both fields are typically the same, the motion vectors which are updated correspond to the movement of relatively small objects, which is the purpose of the claimed invention (otherwise,

small objects may be omitted from interpolated images). Therefore, the conversion takes place by performing the claimed establishing of the first pixel group, the establishing of the second pixel group, the computing and the comparing, as recited in claim 1.

4. Rejection of Claim 14 Under §101

Claim 14 stands rejected under 35 U.S.C. 101 as being directed to non-statutory subject matter because claim 14 recited computer instructions (code) without specifying how the instructions are associated with the medium or the nature of the instructions, and the computer program was not properly associated with the claimed operation.

Claim 14 has been amended to remove "computer readable program code" in favor of reciting a "computer-readable medium encoded with a computer program" for implementing the claimed method. Approval of the amended claim is requested.

5. Rejection of Claims 1-14 Under §103(a)

Claims 1-14 stand rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 5,619,268 (Kobayashi) in view of U.S. Patent 5,398,068 (Lui). The Applicants respectfully traverse this rejection.

Claim 1 recites, among other things, a method of converting a first motion vector field into a second motion vector field, where the first motion vector field is computed on basis of a first image and a second image of a sequence of images for a temporal position between the first image and the second image, by:

> establishing a first group of un-referenced pixels in the first image, by selecting a first set of mutually connected pixels of the first image for which the first motion vector field does not comprise respective motion vectors;
>
> establishing a second group of un-referenced pixels in the second image, by selecting a second set of mutually connected pixels of the second image for which the first motion vector field does not comprise respective motion vectors;

computing a match error of a candidate motion vector, which is oriented from the first group of un-referenced pixels to the second group of un-referenced pixels; and

comparing the match error with a predetermined match threshold and assigning the candidate motion vector to the first one of the motion vectors of the second motion vector field if the match error is below the predetermined match threshold.

Figure 49 of Kobayashi (and the associated text) discloses motion estimation using a bi-directional prediction mode, which utilizes a forward prediction mode in which the current picture is estimated with reference to the past picture, and which utilizes a backward prediction mode in which the current picture is estimated with reference to the future picture. See col. 4, lines 14-24. However, as acknowledged by the Examiner on pages 7-8 of the office action, Kobayashi fails to disclose the first and second establishing steps, the computing step and the comparing step of claim 1.

Lui discloses a method of determining motion vectors for blocks of pixels. For each block, all the pixels of the block are used to estimate its motion vector (see col. 9, lines 24-26), or only a predetermined fraction of the pixels in the block are used to determine its motion vector, as specified by a sparse pixel pattern of the block (see col. 9, lines 40-42; col. 12, lines 44-48). Sparse pixel patterns are shown in Figs. 13-16:

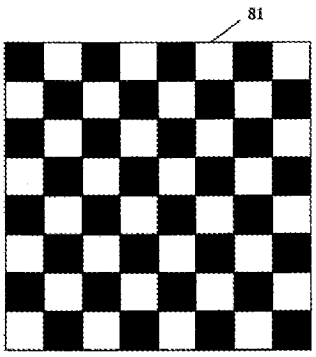

FIG. 13

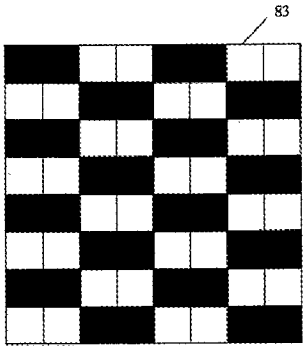

FIG. 14

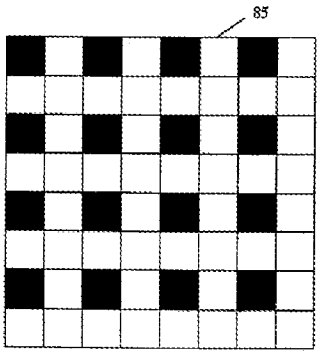

FIG. 15

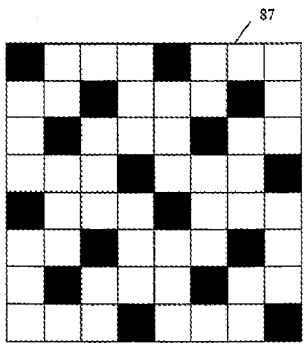

FIG. 16

The dark pixels are those that are used to determine the motion vector for the block (see col. 13, lines 25-26).

Establishing a First Group

On page 8 of the office action, the Examiner states that Lui discloses establishing a first group of un-referenced pixels in the first image, by selecting a first set of **mutually connected pixels** of the first image for which the first motion vector field does not comprise respective motion vectors, as recited in claim 1. The Applicants respectfully traverse, as the light pixels of Fig. 14 are not mutually connected pixels. Instead, they are evenly intermixed among the black pixels (which are used to determine motion vectors). Moreover, the light pixels are selected using the sparse pixel pattern to then calculate a motion vector for the block, without any contemplation of determining which comprise respective motion vectors and which do not. And in fact, before Lui calculates the motion vector for the block of pixels, none of them are associated with motion vectors (i.e. all of the pixels are un-referenced). After Lui calculates the motion vector for the block, all of the pixels are associated with the motion vector for the block (i.e. the motion vector for the block is associated with the entire block, not just those pixels in the block used to calculate the motion vector for the block, and thus none of the pixels are un-referenced).

Establishing a Second Group

On pages 8-9 of the office action, that Examiner states that Lui discloses establishing a second group of un-referenced pixels in the second image, by selecting a second set of mutually connected pixels of the second image for which the first motion vector field does not comprise respective motion vectors, as recited in claim 1. The Applicants respectfully traverse, as there is no apparent contemplation of applying Fig. 14 to a second subsequent image, let alone based on pixels of the second image for which the first motion vector field does not comprise respective motion vectors. Lui only appears to contemplate generating a motion vector for the entire block represented by selected pixels of Fig. 14. Additionally, as stated above, the light pixels relied upon by the Examiner are not mutually connected pixels, are not selected as a set of mutually connected pixels of the first image which lack motion vectors, and are not un-referenced as recited by claim 1.

With respect to Lui's failure to contemplate forward and backward image consideration, the Examiner relies on Kobayashi, stating it would have been obvious to modify Kobayashi (which discloses both forward and backward prediction modes in estimating a picture), apparently taking the position that it would have obvious to apply the technique of Lui twice (once from a future picture and once from a past picture) in determining motion vectors, "for the purpose of reducing the complexity for motion estimation." The Applicants respectfully traverse. There is no apparent disclosure in either Kobayashi or Lui of resolving different motion vectors resulting from the two applications of the Lui technique for the same block of pixels. The Examiner's proposed combination of these two references would result in two different sets of motion vectors for any given block of pixels, without any disclosure of how to resolve them to come up with the single set of motion vectors for picture estimation. Moreover, resolving discrepancies between the two sets of motion vectors would increase complexity, not decrease it as stated in the motivation to combine.

Computing and Comparing Match Error

Claim 1 further recites computing a match error of a candidate motion vector, which is oriented from the first group of un-referenced pixels to the second group of un-referenced pixels; and comparing the match error with a predetermined match threshold and assigning the candidate motion vector to the first one of the motion vectors of the second motion vector field if the match error is below the predetermined match threshold. The Examiner first acknowledges in the first paragraph of page 9 of the office action that the combination of Kobayashi and Liu fails to disclose the recited computing and comparing steps. Then, the second paragraph of page 9 concludes that Kobayashi discloses computing a match error of a candidate motion vector (citing to Fig. 51), and therefore it would have been obvious to change the first one of the motion vector if the block match error is below the predetermined match threshold (for the purpose of improvement of the motion vector accuracy). The Applicants respectfully traverse. First, support for Fig. 51 of Kobayashi can be found in col. 5, lines 1-60, which discloses scaling the motion vector (lines 14+), calculating interpolated bocks (lines

26+), calculating distortion values (lines 29+), selecting a minimum distortion value (lines 32+), shifting the field motion vector (lines 40+), and so on. There is no contemplation of computing a match error of a candidate motion vector oriented from the first to the second groups of un-referenced pixels, and comparing the match error to a predetermine match threshold where the candidate motion vector is assigned to the one of the motion vectors if the match error is below the threshold, as recited in claim 1.

Therefore, for the above reasons, it is respectfully submitted that claim 1 is not rendered obvious by Kobayashi in view of Lui. Claims 9 and 14 include recitations similar to those of claim 1, and are therefore considered allowable as well. Claims 2-8 and 10-13 depend from the above independent claims, and are therefore considered allowable over the cited art for the same reasons discussed above for claim 1.

In view of the above, it is respectfully submitted that this application is in condition for allowance, and action to that end is respectfully requested.

Respectfully submitted,

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